SORBONNE UNIVERSITÉ

Course description

Advanced Machine Learning (MLA)

M2 Engineering of Intelligent Systems

& Advanced Systems and Robotics

2022-2023

Responsible and instructors

Nicolas Obin

Responsible & instructor

C1 - ML

C6 - RNN

C7 - AE, GAN

Olivier Sigaud

Instructor

C2 - RL

Kevin Bailly

Responsible & instructor

C3 – MLP and back-propagation

C4 – DNN

C5 - CNN

Edouard Yvinec

C8 – NN acceleration

Objectives

- The aim of this course (60h.) is to train students in advanced machine learning techniques such as reinforcement learning and deep learning

- Starting from the basics of machine learning and neural networks, the course introduces the key concepts of neural networks, from their theoretical definition to their practical optimization, and presents classical architectures such as CNN, RNN, and GAN.

Pre-requisites

- This course is part of the **Master of Engineering in Intelligent Systems** from Sorbonne Université

- The course follows the M1 courses (Introduction to Artificial Intelligence, Machine Learning), and offers a solid background for most of the courses presented in the M2 (Advanced Image and Audio Processing, Robotics, Biometrics, etc…)

- Students must have preliminary knowledge in machine learning and are **strongly encouraged** to have taken the **« Machine Learning »** course in M1-S2 or equivalent.

Course syllabus

C1/TP1 (4h) – **Introduction to machine learning**

C2/TP2 (4h) – **Tabular reinforcement learning**

C3/TP3-TP4 (6h) – **Fundamentals of neural networks** (backpropagation and gradient descent), presentation of **deep learning environments** in Python (PyTorch, TensorFlow…)

C4/TP5 (4h) – **Introduction to deep learning** (definition, applications, challenges), **optimization and regularization** (Adam, batch norm, dropout, data augmentation, …)

Course syllabus

C5/TP6 (4h) – **Convolutional neural networks** (CNN)

C6/TP7 (4h) – **Recurrent neural networks** (RNN)

C7/TP8 (4h) - **Auto-encoders, generative adversarial networks**

C8-C9/TP9 (4h) – Neural-network **acceleration** & **compression**

Resources for students

Lectures notes & videos

Jupyter notebooks: illustrations, exercises

Access to the GPU server (in collaboration with the Sorbonne Center for Artificial Intelligence)

Room 226, Esclangon building

Resources and information on Moodle

Grading

1 written exam: 2h (/40), from lectures

General understanding, theoretical background

4 on-going exams: (/20), free form (written, TP, QCM, etc…).

One by each instructor

1 project evaluation: monitoring, report., code (/40)

Ability to implement a complex architecture on a competitive task

Project

Groups of 3/4 students

Reimplementation of a research paper, and reproduction of the experimental results

Organization:

- **20 hours**
- Self-organization and free access to GPU server

Provisional planning

ALL	FI + APP												FI							
	Lundi				Mardi				Mercredi				Jeudi				Vendredi			
	8h30	10h45	13h45	16h	8h30	10h45	13h45	16h	8h30	10h45	13h45	16h	8h30	10h45	13h45	16h	8h30	10h45	13h45	16h
S0 (12/9)							Réunion de rentrée						Date limite de choix des options						Diffusion des options	
S1 (19/9)	MLA - C1 / TP1		Son - C1	Img - C1			Img - C2	PFE - A1		MLA - C2 / TP2	GLog - C1&2			BM - C1	VB - C1		VB - TD1			
											App - C1 & 2		Com - C1	Com - TD1						
S2 (26/9)	MLA - C2 / TP3		Son - C2	Img - C3	Img - TP1 G1		Son - C3	PFE - C1	MLA - C3 / TP4 (RL tabulaire)					BM - C2	Journée Poster (manque : VB - C2)		VB - TD2	RV - C1.1	Img - TP1 G2-3	
											App - C3		Com - C2	Com - TD2			IA pour Rob - C1			
S3 (3/10)	MLA - C4 / TP5		Img - TP2 G1		GLog - C2&3		PFE - Gestion	PFE - Projet	MLA - C5 / TP6		GLog - C3&4			BM - C3	RV - C1.2	VB - C3	VB - TD3	RV - TP1		
					App - TP1						App - C4	Hap - C1	Com - C3	Com - TD3			IA pour Rob - TP1			
S4 (10/10)	Hap - C2	Son - ER1	Son - C4	Img - C4	GLog - Q1	GLog - C4	PFE - Gestion	PFE - Projet	MLA - C6 / TP7					BM - C4	RV - C2.2	VB - C4	VB - TD4	RV - C2.1	Img - TP2 G2-3	
					App - C5	App - TP2.1					App - C6	Hap - C3	Com - C4	Com - TD4			IA pour Rob - C2			
S5 (17/10)	MLA - C7 / TP8		Son - C5	Img - C5			PFE - Ingé Système	PFE - Projet	MLA - C8 / TP9		GLog - C5&6			BM - C5	RV - ER1	VB - C5	VB - TD5	RV - C3.1	BM - TP1	
					App - C7	App - TP2.2				App - TP2.3	Hap - TP1			Com - C5			IA pour Rob - TP2			
S6 (24/10)	Son - C6	Img - C6	Img - TP3 G1		Glog - C6			PFE - Ingé Système	MLA - C9 / TP9					BM - C6	RV - TP2		VB - TP1		Img - TP3 G2-3	
					App - TP3		RS - C1				RS - C2	Hap - C4		Com - C6	Com - TP1		IA pour Rob - C3			
S7 (31/10)	Vacances Toussaint																			
S8 (7/11)		GLog - Q2			GLog - C7		PFE - Ingé Système	PFE - Projet	MLA - Projet		IA pour Rob - TP3		BM - TP2		RV - C4.1	RV - TP3	Férié (manque : VB - TP2 G1)			
	Plan - C1	Plan - TD1			App - ER								Com - TP2							
S9 (14/11)	GLog - C7	GLog - ER	Son - TP1 G1		Img - TP4 G1		PFE - Projet		Son - TP1 G2		GLog - C8		Atrium des métiers					RV - C3.2	Son - TP1 G3	
	Plan - C2	Plan - TD2									Hap - TP2							IA pour Rob - C4		
S10 (21/11)	GLog - C8	Log - TP No	Son - TP2 G1		GLog - Projet 1		PFE - Projet		MLA - Projet		Son - TP2 G2		Img - TP4 G2-3		RV - C4.2	BM - C7		RV - C5	Son - TP2 G3	
	Plan - TP1				RS - TP1						Hap - TP3						RS - C3 & 4			
S11 (28/11)			Son - TP3 G1				PFE - Projet		Son - TP3 G2				RV - ER2	BM - C8	VB - TP2 G2		BM - TP3		Son - TP3 G3	
	Plan - C3	Plan - TD3									Hap - TP4			Com - ER			RS - C5 & 6			
S12 (5/12)			Img - ER		GLog - Projet 2		PFE - Projet		MLA - Projet					BM - C9	RV - TP3			VB - ER		
	Plan - TP2					RS - C7					Hap - TP5			IA pour Rob - ER			RS - TP2			
S13 (12/12)							PFE - Projet		Son - TP4 G1		Son - ER2 (1h)			BM - ER	Son - TP4 G2				Son - TP4 G3	
	Plan - TP3		Plan - TP 4		RS - TP3													RS - ER		
S14 (19/12)	Vacances Noël																			
S15 (26/12)																				
S16 (2/1)					GLog - Projet 3		PFE - Projet			MLA - ER										
S17 (9/1)		Plan - ER											PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet	
S18 (16/1)	PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet	
S19 (23/1)	PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet	
S20 (30/1)	PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Projet		PFE - Evaluation		PFE - Evaluation		PFE - Evaluation		PFE - Evaluation	
S21 (6/2)																				
S22 (13/2)	Rattrapage												Rattrapage							

SORBONNE UNIVERSITÉ

Course description

Advanced Machine Learning (MLA)

M2 Engineering of Intelligent Systems

& Advanced Systems and Robotics

2022-2023